

## A NEW EUCALYPT FROM WESTERN AUSTRALIA

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## Abstract

A new species (*Eucalyptus roycei*) is described. It is shown to resemble *E. jucunda* C. A. Gardner. Both are to be included in the 'eudesmioid complex'. The new species is restricted to a single locality in which it occurs as a relatively very small population, in which there is considerable variation.

## Introduction

In 1966 collections were made in the Shark Bay area of Western Australia of an unidentified species of *Eucalyptus* which has on subsequent study proved to be a new species. A specimen had originally been brought to the Western Australian Herbarium by Mr J. R. Ford, who collected it in 1964. Further collections were made by two of the authors in 1968, by Mr John Lee Steere of Hamelin Station, by Mr P. Maxwell and by Mr J. P. Kruiskamp, CSIRO. All the collections are from the only known locality which lies along the road between Hamelin and Tamala Station Homesteads (Map, Fig. 1). The number of trees of the species in the locality is not known but is certainly well under five hundred. We have been unable to find the species at places on the Tamala Road other than the one indicated, nor could it be found in a search of the area traversed by the Hamelin-Denham Road, nor along the Tamala-Murchison House track.

## Diagnosis and Description

*Eucalyptus roycei* S. G. M. Carr, D. J. Carr et A. S. George; sp. nov. affinis

*E. jucundae* C. A. Gardner sed ab ea foliis latis, alabastris glaucis angulatis, fructibus angulatis differt.

Arbor vel frutex parvus 1.5-6 m altus, plerumque pluricaulis et asymmetricice formatus (lignotuber nullum visum). Glandulae oleosae et in cortice et in medulla praesentes. Cortex laevis, primum fulvo-hinnulea, demum cinerascens. Folia petiolata, nunc opposita nunc cum intranodiis brevibus longisque, lanceolata vel ovato-lanceolata, symmetrica vel parum falcata, coriacea, viridia, opaca, concoloria; costa mediana distincta, utrinque fere aequaliter perceptibilis; vena intramarginalis ab margine distans; venae laterales ab costa mediana sub angulo circa 30° prodeuntes. Inflorescentia basitonica. Inflorescentia singulae axillares ab nodo tertio ad nodum sextum surculi annui, vel in ramulis lateralibus ab his nodis exorientibus, a prophyllis deciduo vel foliis subtentae.

Gemmae inapertae inflorescentiae rotundae, gongylodes. Inflorescentiae singulae

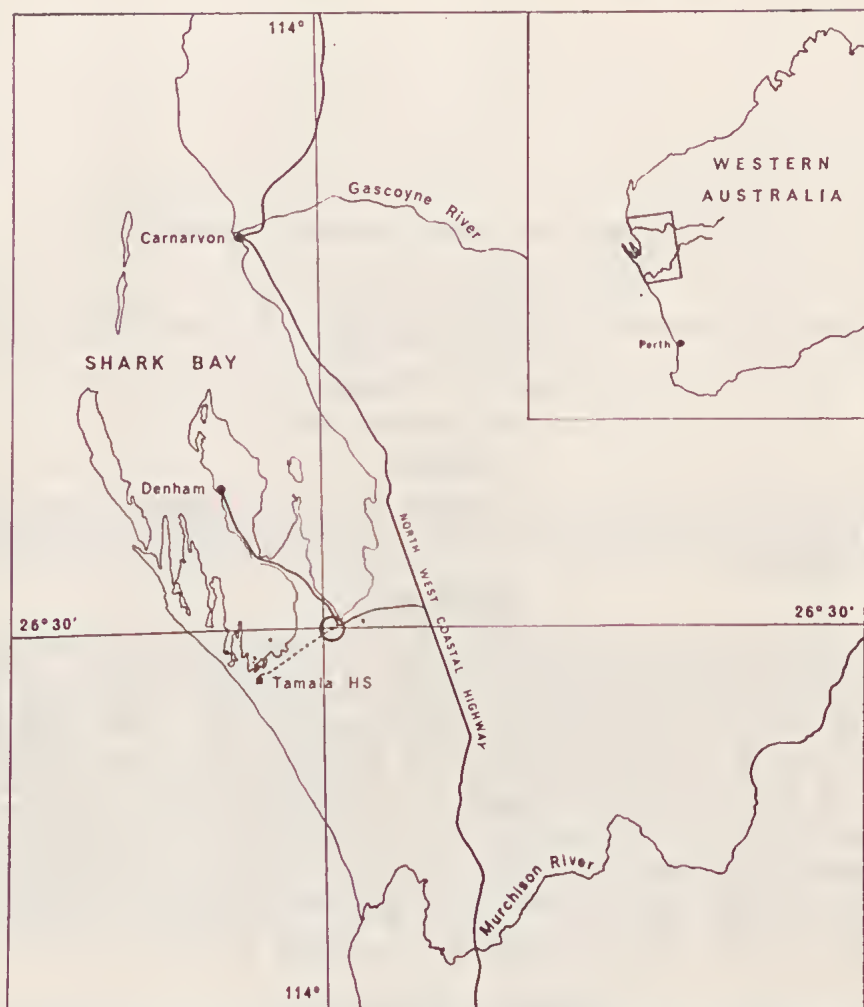


FIG. 1—Map of locality of *E. roycei* (the circled dot). Hamelin Station is very close to the junction of the roads leading to Denham and Tamala Station Homestead.

compositae, ex tribus inflorescentiis sessilibus simplicibus constantes, unaquisque flores tres vel pauciores continens. Pedunculus communis maturitate (8-) 12 (-15) mm longus, sursum dilatatus. Alabastra glaucissima (3-) 4 (-5) -angulata, 12-17 mm longa, 6.5-9 mm lata, breviter pedicellata (2-4 mm). Hypanthium cupulatum, angulatum sed cetero laeve, plerumque quam operculum parum longius, interdum multo longius, in pedicello contractum. Operculum hemisphaericum, apice depresso vel mitriforme vel pyramidale, singulare, vel ab corolla vel ab corolla et calyce conjuncto oriundum. Orificium floris angulatum, planum vel undulatum. Stamina 3-4-seriata, omnia fertilia; staminophorum continuum, non elevatum, cum orificio conforme. Filamenta luteola, 10-12 mm longa, glandulas oleosas continentia, in alabastra non semper inflexa, ad medium antherarum in-

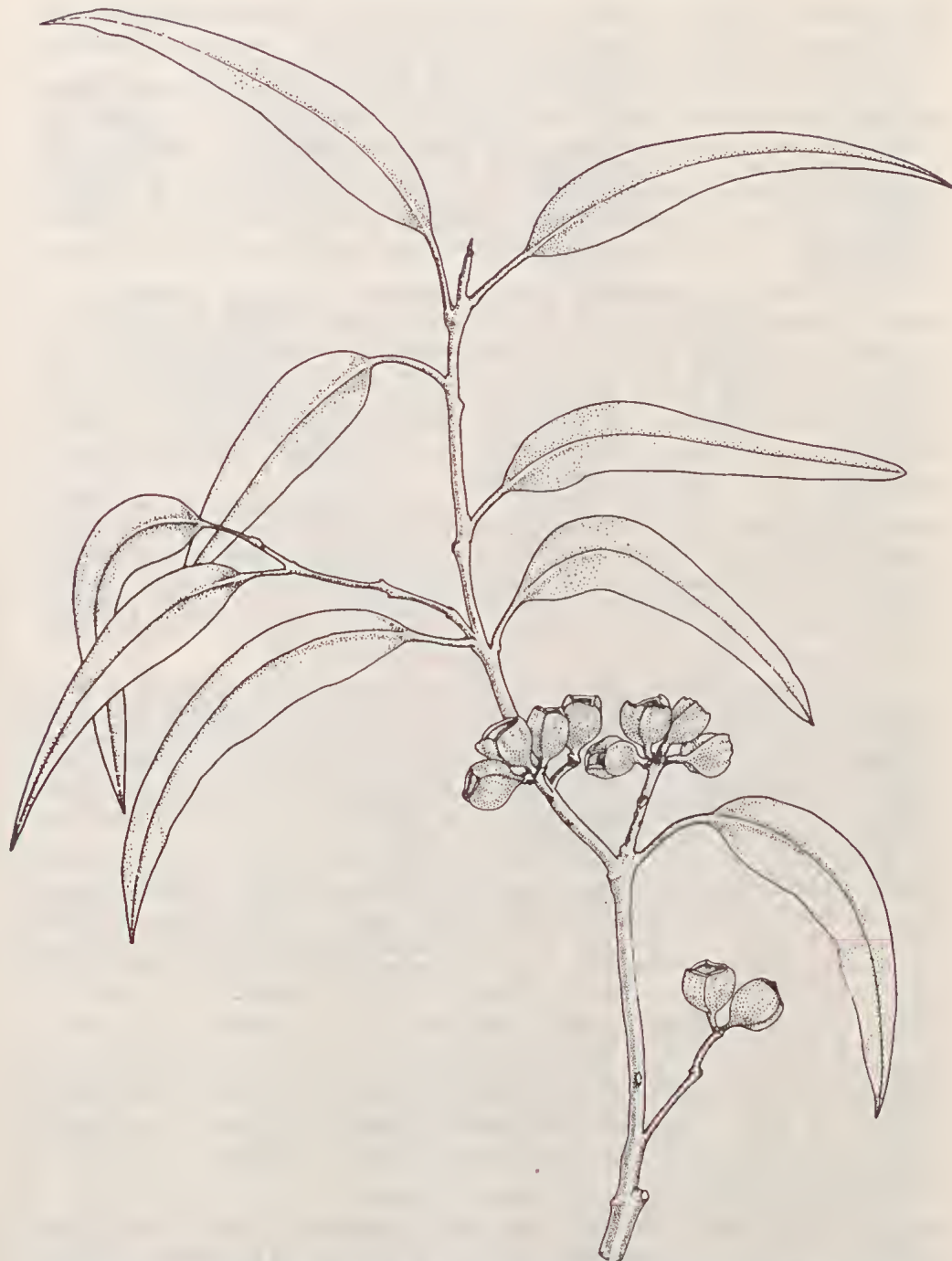


FIG. 2—Fruiting branch of *E. roycei* (Kruiskamp, CANB.) ( $\times 0.5$ ). The inflorescences are borne on lateral shoots which arise near the base of the annual shoot and which, by loss of the terminal buds and deciduous prophylls, become leafless fruiting shoots of determinate growth. In the branch shown there are also two such shoots axillary to the sixth pair of leaves (shed).



serta. Anthrac versatiles, 1.0-1.3 mm. longae, a rimis lateralibus longitudinalibus dehiscences, glandulibus terminalibus non nisi dorsaliter manifestis, connectivo inconspicuo sub insertione filamentorum, sine glandulis accessoriis.

Nectarium ad tubum floris affixum, interdum super stylopodium sed nunquam ad basin styli extensum. Stylopodium breviter pyramidale; stylus elongatus (18-21 mm longus), proportionem cum longitudine angustissimus, in alabastro inter stamina irregulariter plicatus et torsivus, demum rectus vel sinuatus; stigma inconspicua. Ovarium inferum, multo (circa dimidio) brevius quam hypanthium; loculi 3 (-4). Structurae ovulares circa 12-seriales transversaliter, et 4 (-6)-seriales longitudinaliter. Ovula hemitropa, marginalia, ad dimidium proximale placentae limitata.

Fructus breviter pedicellatus, lignosus, cupulatus, angulatus, plerumque compressus lateribus 4 (interdum 3 vel 5) truncato-ovatis, plerumque ad orificium constrictus et circa medium lator; orificium angulatum, non planum, partes infimae cristis longitudinalibus fructus oppositae; tubus ab nectario verticale vel valde descendente velatus; valvae graciles, profunde inclusae, erectae, breviter triangulares, ab basi persistente styli terminatae. Semina alata, schistacea. Cotyledones emarginatae, reniformes. Folia plantulae cum caespitibus stellatus pilorum in marginibus et interdum in pagina abaxiale.

A small tree or shrub 1.5-6 m tall, usually several-stemmed and of irregular form (no lignotuber seen). Oil glands present in both bark and pith. Bark smooth, yellow-fawn when fresh, grey when old. Leaves stalked, opposite or with short or long intranodes, lanceolate or ovate-lanceolate, symmetrical or slightly falcate, coriaceous, green, concolorous, the midrib distinct and almost equally prominent on both sides of the lamina. Intramarginal vein distant from the margin, lateral veins making an angle of about 30° with the midrib (Pl. 15, fig. 1).

Inflorescence basitonic. Individual inflorescences axillary at the third to the sixth nodes of the annual shoot or on lateral branches which arise at these nodes (Fig. 2); inflorescences subtended by deciduous prophylls or by leaves. Unopened inflorescence buds rounded and knob-like (Fig. 8, 1{c}). Individual inflorescences compound, consisting of three sessile unit inflorescences, each of which contains three flowers or fewer. Common peduncle at maturity (8-) 12-15 mm long, more or less isodiametric, slightly broader at the top.

Buds very glaucous (3-) 4 (-5)-angled, 12-15 mm long, 6.5-9 mm broad, shortly-stalked (2-4 mm). Hypanthium cup-shaped, angular but otherwise smooth, tapering into the pedicel, usually only slightly longer than the operculum, sometimes much longer than it (Fig. 3). Operculum hemispherical with a depressed tip or mitre-shaped or pyramidal, single, consisting of the derivatives of the corolla only or of the fused derivatives of both calyx and corolla (Pl. 15, fig. 2-5). Orifice of the flower angular, plane or undulate (Fig. 4). Stamens in 3-4 series, all fertile; staminophore continuous, not raised, conforming to the shape of the orifice. Filaments pale yellow, 10-12 mm long, glandular, not always inflexed in bud, inserted about the middle of the anthers. Anthers versatile, 1.0-1.3 mm long, opening by lateral longitudinal slits, terminal gland visible only on the dorsal surface, connective inconspicuous below the insertion of the filament and with no accessory glands (Fig. 4).

Nectary lining the tube of the flower, sometimes extending over part of the stylopodium but never to the base of the style. Stylopodium shortly pyramidal, style elongated (18-21 mm long), very narrow in proportion to its length, irregularly folded and coiled among the stamens in bud, later straight or sinuous, stigma inconspicuous (Figs. 4, 7). Ovary inferior, much shorter than the hypanthium

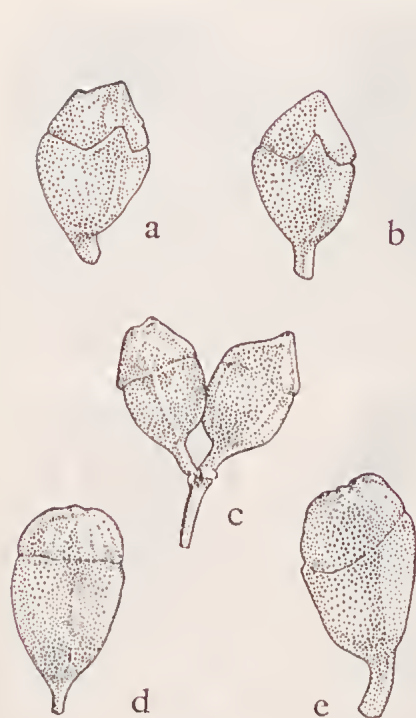


FIG. 3—Representative flower buds (a, b, and c from E.M.S. and S.G.M.C. No. 284, d and e from E.M.S. and S.G.M.C. No. 293). (a) and (b) ( $\times 1.5$ ). These buds have sepal teeth at the orifice of the bud. The teeth are deciduous with the operculum at anthesis. (a) has three teeth, (b) two. (c) ( $\times 1.1$ ). The operculum structure resembles that of most members of *Eudesmicaceae* B (see text) and there is no evidence of sepal teeth. (d) ( $\times 1.5$ ) and (e) ( $\times 1.7$ ). These represent a form with a depressed (d) or mitre-shaped (e) tip. Neither has sepal teeth. The buds are in all cases very glaucous.

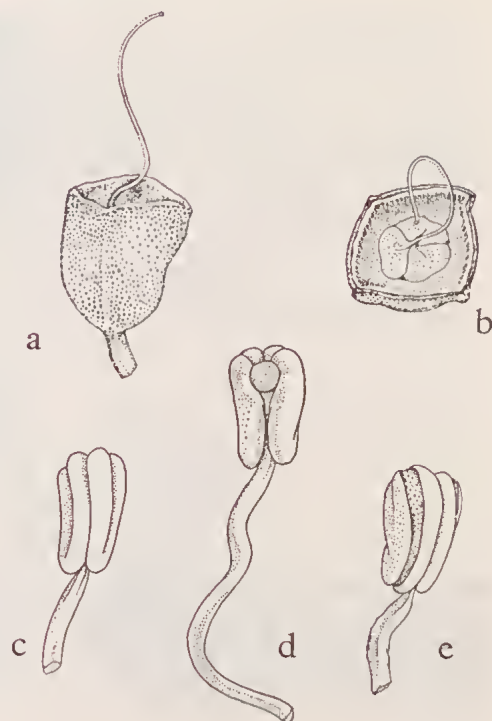


FIG. 4—Style and stamens (E.M.S. and S.G.M.C. No. 293). (a) Flower after the stamens have been shed. The style is long, thin and curved and without a prominent stigma ( $\times 1.5$ ). (b) Another bud, viewed from above to show the somewhat rhomboidal outline and the expanded, angular stylopodium, here with three facets. (c) and (e) Stamens, adaxial view, (e) to show the mode of dehiscence. (d) Stamen, abaxial view (all stamens  $\times 15$ ).

(approximately half as long), loculi 3 (-4). Ovular structures in approximately 12 transverse rows and 4 (-6) longitudinal rows. Ovules hemitropous, marginal, confined to the proximal half of the placenta (Fig. 7).

Fruit woody, cup-shaped, angled, usually compressed and with 4 (sometimes 3 or 5) truncate-ovate facets, shortly stalked, usually constricted at the orifice and broadest at or below the middle; valves thin, deeply-enclosed, erect, shortly-triangular, terminated by the persistent base of the style; tube lined by the vertical or steeply-descending nectary (Figs. 5 and 6). Orifice angular and not level, the lowest points being situated opposite the longitudinal ridges of the fruit. Seeds winged, dull dark grey (Fig. 7). Cotyledons emarginate, reniform. Seedling leaves

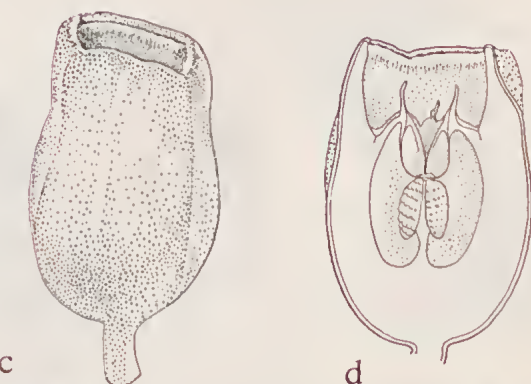
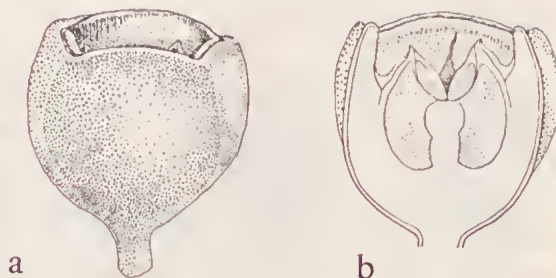


FIG. 5—Fruits and sections of fruits ( $\times 1.5$ ). (a) and (b) from E.M.S. and S.G.M.C. No. 284, (c) and (d) from E.M.S. and S.G.M.C. No. 297. In each case the fruits are of shapes characteristic for the parent trees.

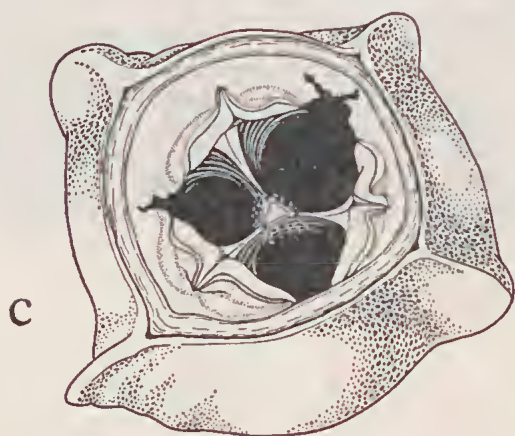
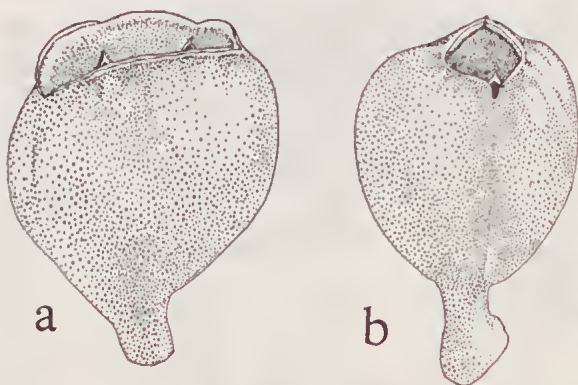


FIG. 6—Fruits. (a) Fruit of E.M.S. and S.G.M.C. No. 286 ( $\times 1.7$ ), (b) E.M.S. and S.G.M.C. No. 282 ( $\times 1.5$ ), (c) valve view of opened fruit (E.M.S. and S.G.M.C. No. 284 ( $\times 3$ )). This shows the septa and, subtending the loculi, the placentae with scars of attachment of ovules and ovulodes which have all been shed. Note the relatively small valves.



with stellate tufts of hairs on the margins and sometimes on the lower surface.

The buds (Fig. 3) and fruits (Figs. 5 and 6) of the species are variable in shape and size but the variations are characteristic of individual trees. The description has been prepared by reference to the specimens listed below.

WESTERN AUSTRALIA: 25 m NE. of Tamala Station Homestead, 16.viii.1964, J. R. Ford. Near Hamelin Pool (between 26°29'S., 114°03'E. and 26°31'S., 114°01'E.).—2.iii.1966, E. M. Scrymgeour and S. G. M. Carr 282, 284, 286, 293, 297; 16.iii.1968, D. J. Carr and S. G. M. Carr 400; 17.iii.1968, D. J. Carr and S. G. M. Carr 416, 417, 419, 420; viii.1968, P. Maxwell; 2, 6 and 8 miles from Denham Turnoff, 23.iii.1969, J. P. Kruiskamp (CANB).

TYPE: E. M. Scrymgeour and S. G. M. Carr 284. PERTH; paratypes, E. M. Scrymgeour and S. G. M. Carr 293, 297. PERTH.

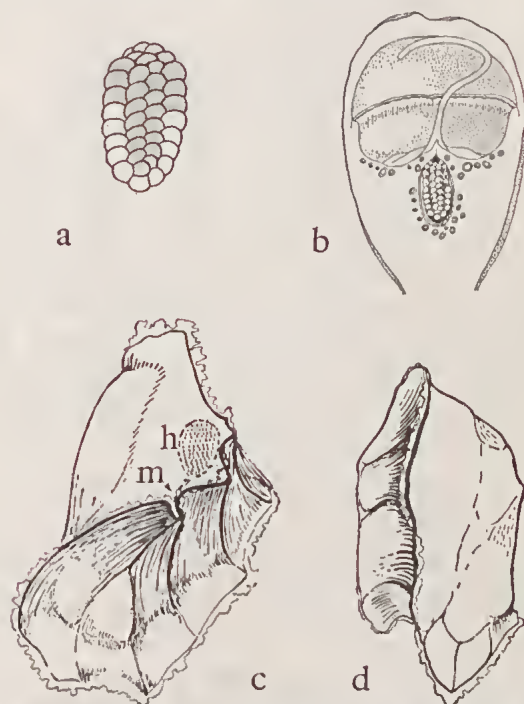


FIG. 7—(a) Diagram of the disposition of ovules (not shaded) and ovulodes (shaded) on the placenta. (b) Section of mature flower (E.M.S. and S.G.M.C. No. 293) before anthesis, stamens removed for clarity. The position of the style is as in the intact flower bud. The section exposes the placenta of the one of the loculi. (c) ( $\times 11$ ) and (d) ( $\times 12$ ), seeds; h = hilum, m indicates position of micropyle.

The species is known only from the locality cited above (Map, Fig. 1). It occurs on red calcareous sand in association with *E. dongarraensis* Maiden & Blakely, *E. jutsonii* Maiden and *E. eudesmoides* F. Muell. It is allied to *E. jucunda* C. A. Gardner, but is distinguished from it by the broad leaves, by the glaucous angular buds and by the angular fruits. It is named in honour of Mr R. D. Royce, Curator, Western Australian Herbarium.

### Discussion

*Eucalyptus roycei* is of great interest because of the remarkable variations in structure and development of its operculum. Taken together with a number of other characters, both floral and vegetative, the structure of its operculum clearly indicates that it is a member of the group, including the Eudesmieae (Benth.) Blakely and some other species, which we have previously referred to as the 'eudesmioid complex' (Carr & Carr 1968). We have shown that in the species of this complex two patterns of development and structure of the operculum are clearly distinguishable. In those species grouped as Eudesmieae A, the operculum consists solely of the fused petals (Fig. 8, 2{a-d}). The primordia of the sepals, although relatively large in early stages of flower development, are soon arrested in growth and do not become fused laterally to each other or to the petal primordia; the latter do become fused at their edges or grow by a common basal meristem to form the operculum. The sepals are present in the mature flower as separate teeth at its orifice and they persist in this position on the fruit. *E. tetradonta* F. Muell., *E. tetragona* (R. Br.) F. Muell., *E. gamophylla* F. Muell., *E. odontocarpa* F. Muell., and *E. erythrocorys* F. Muell., belong in this group.

In the species of Eudesmieae B, separate petal and sepal primordia are present at the earliest stages of flower development but apical growth of these primordia is soon suppressed in favour of that of a tubular meristem, common to both whorls (Fig. 8, 3{a-d}). This meristem produces a tube at the mouth of which the sepal and petal primordia appear as separate tips. The greater part of the operculum is formed from this tube which must be regarded as derived from the congenitally concrescent bases of all the members of both perianth whorls. The only evidence in the mature flower of the initial presence of separate sepal and petal primordia, evident in very early stages of development, may be minute and indistinct lobes at the tip of the operculum (Fig. 8, 3{d}). The degree of concrescence varies with the species. The normal mode of development may be disturbed so that the growth of the individual primordia may be unusually prolonged. When this happens, as it frequently does in *E. similis* Maiden, *E. lirata* W. V. Fitzg. ex Maiden, *E. baileyana* F. Muell. and *E. ebhanoensis* Maiden, at least some of the sepals can be identified as distinct teeth on the mature flower bud. The petal primordia may also continue to grow independently of each other, producing bizarre outgrowths descending like streamers into the interior of the flower (Carr & Carr 1968). At the other extreme, in *E. jucunda*, *E. miniata* A. Cunn. ex Schau. and *E. phoenicea* F. Muell., the tip growth of the perianth primordia is arrested so early in flower development that their free parts are exceedingly minute and there is practically no possibility of demonstrating their presence in the mature flower bud. In *E. jucunda*, however, sepal lobes can sometimes be distinguished on the flower bud up to the stage when the bracts are shed.

In the majority of buds of *E. roycei* the operculum has the mode of development and structure characteristic of Eudesmieae B (Pl. 15, figs. 2 and 3). Occasionally buds are produced in which the perianth conforms more to the pattern of Eudesmieae A in that sepal teeth occur at the orifice of the mature flower (Pl. 15, fig. 5). In other flower buds the structure of the operculum is intermediate and the outlines of individual sepals which are fused to the essentially petaline operculum can be made out (Fig. 3, Pl. 15, fig. 4).

In other characteristics *E. roycei* resembles members of the eudesmioid complex. The long, thin style, which in the unopened flower is coiled among the stamens, is like those of *E. jucunda*, *E. miniata* and *E. phoenicea*. The maximum number of longitudinal rows of ovular structures is 6. In this, and in the arrange-



ment of the ovules and ovulodes, *E. roycei* conforms to the general eudesmioid pattern. However, as shown above, there are features of its floral development by which it links Eudesmieae A and Eudesmieae B.

We have shown elsewhere (Carr & Carr 1969) that the presence or absence of oil glands in the pith and bark (phloem) of eucalypts has considerable taxonomic significance and, in particular, that oil glands are found in both these tissues only in certain species of the eudesmioid complex. In that publication we showed that *E. roycei* (designated 'New Species A' because it had not at that time been described) has glands in both pith and bark.

In inflorescence characters *E. roycei* is closest to *E. jucunda*. In both species the inflorescences appear to be simple. They are in fact compound (Fig. 8, 1{a-c}). This is very obvious in those cases in which the internodes of the inflorescences elongate. However, the usual situation is that the three simple inflorescences, which together make up the compound one, remain sessile. The disposition of the bracts shows that the inflorescence is not a simple dichasium as the anterior and posterior positions are each occupied by a single bract (series 2 of the central inflorescence) (Fig. 8, 1{c}). In the simple unit inflorescence characteristic of most eucalypts (including some members of the eudesmioid complex), the anterior and posterior positions are each occupied by paired bracts (series 3 in the normal dichasial sequence (Fig 8, 1{a})) (Carr & Carr 1959). The lateral bracts of the general involucre of *E. roycei* and *E. jucunda* are equivalent to the bracts of series 1 in a simple dichasium. They subtend the lateral inflorescences.

Chippendale (1969) places *E. jucunda* with *E. pachyloma* Benth., *E. diversifolia* Bonpl., *E. todtiana* F. Muell. and *E. patens* Benth., in series Diversiformae (section Renantheroideae, Blakely 1965). As *E. jucunda* and *E. roycei* resemble each other closely, it is relevant to discuss the systematic position of *E. jucunda* at this point. In the members of Renantheroideae the operculum differs radically in structure and development from that of *E. jucunda*. In addition, the ovules and, in most cases, the ovulodes as well are in two longitudinal rows (Carr & Carr 1962), the ovules and seeds are anatropous, matching those of Renantherae and Renantherae (Normales) as described by Gauba and Pryor (1959), the style is straight in bud, the inflorescence is simple. Finally, no species of Renantheroideae has glands in either the pith or the bark. *E. jucunda* has glands in both tissues (Carr & Carr 1969). It therefore appears that *E. jucunda* has no essential character in common with the members of Renantheroideae. On the other hand the structure of its operculum, the placentation pattern, the 'hemitropous' seeds and other characters which have been discussed earlier bring it well within the limits of the 'eudesmioid complex'.

Variation in size and shape of the buds and fruits of a single tree of *E. roycei* is usually small, compared with the variation from tree to tree. This reflects the very small size of the breeding population, which is further reduced by very large annual losses of flower buds, presumably due to drought, as judged by the paucity of flowering in the years 1966 and 1968, and the large numbers of dried, half-grown buds on the ground under the trees. The possibility of genetic drift in such a population is of course high and it may well be that this is a factor contributing to the variability of *E. roycei* in its single locality. The species thus offers an interesting problem in variation and evolution and it is to be hoped that the small population of trees will be preserved. The area in which it occurs is grazed and the vegetation in the vicinity has been burned from time to time.

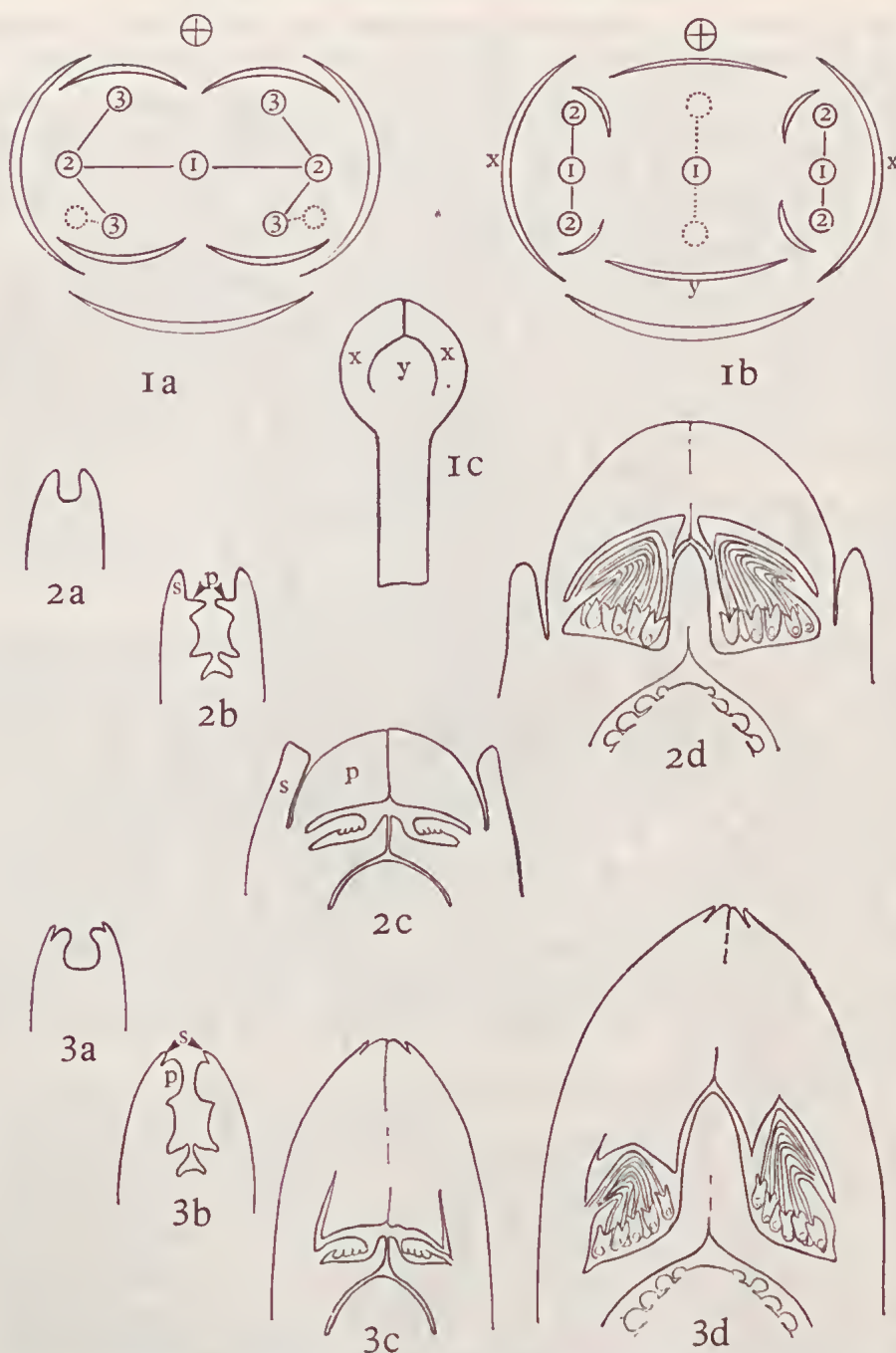


FIG. 8—1. Diagrams to illustrate structure of (a) simple unit inflorescence characteristic of many eucalypts, (b) compound inflorescence as in *E. roycei* and *E. jucunda*. The numbering of the flowers indicates the order of branching within the unit inflorescences. Flower no. 1 terminates an axis bearing two bracteoles, in the axils of which flowers no. 2 are borne, and so on. In each diagram the presumptive positions of two additional flowers (to make 9-flowered inflorescences) are shown. 1 (c). Anterior view of a young inflorescence bud of *E. roycei*, indicating the bracts marked x and y of the diagram 1 (b). 2 (a-d). Diagrams to illustrate floral development in Eudesmieae A. 3 (a-d). Diagrams to illustrate floral development in Eudesmieae B. p = petal, s = sepal.

### Acknowledgements

We wish to thank Mrs J. H. Hamersley for her invaluable assistance and Mr P. Maxwell and Mr J. Lee Steere for collecting material for us. Mrs J. Goodrum prepared most of the line drawings. A grant made by the Commonwealth-Nuffield Foundation enabled one of us (S. G. M. Carr) to collect material of *E. roycei* in 1966.

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### Explanation of Plate No. 15

- Fig. 1—Leaf of *E. roycei*, to show venation (circa  $\times 1$ ).
- Fig. 2—Flower primordium, L.S. ( $\times 200$ ). s = sepal, p = petal.
- Fig. 3—Terminal flower primordium, T.S. ( $\times 185$ ). v = vascular bundle of sepal.
- Fig. 4—Flower of E.M.S. and S.G.M.C. No. 284, to show outlines of three sepal teeth (s) fused to the essentially petaline operculum ( $\times 9$ ).
- Fig. 5—Flower of E.M.S. and S.G.M.C. No. 284, showing a single free sepal, attached at the future orifice of the flower ( $\times 7.2$ ).

### Addendum

In a previous publication (Carr & Carr 1963) we suggested the exclusion of *E. lirata* W. V. Fitzg. ex Maiden from series Eudesmiceae mainly on the results of an examination of flower buds, presented to us by Mr C. A. Gardner and said by him to be of that species. We have since learned that they were, in fact, of *E. cupularis* C. A. Gardner. At that time no authentic flowering material of *E. lirata* was available to us. Since then, a number of collections including buds and flowers have been made and from these and from anatomical studies it is quite clear that the species should be regarded as a member of series Eudesmiceae. It is hoped to publish a more detailed account, including an analysis of the flowers of *E. lirata*, in due course.

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